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Chapter

Perspective Chapter: The Pivotal Role of Vaccines and Interventional Equity and Appropriateness

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Abstract

The current COVID-19 pandemic saw the world deploying the latest technology as fast as it could to tackle the situation hurriedly. The world saw vaccine “grabbing” of immense magnitude from the most powerful nations which some defined as vaccine apartheid. This deprived less powerful nations of timely access to the vaccine meant to interrupt the pandemic. Moreover, countries were faced with a generalized approach to the response which may have exacerbated existing inequities and further entrenched deprivations not just at the subnational levels but between nations as well. Once the stronger nations have had enough of their hoarded vaccines, these were then dumped on these weaker nations with additional consequences. This chapter explores the dynamics at play and what could be done better going further.

Keywords: equity, appropriate interventions, vaccine apartheid, vaccine diplomacy, global health

1. Introduction

The world needs to be better prepared to adequately mitigate and respond to global health emergencies. With the unprecedented response mounted to control the COVID-19 pandemic of recent, lessons are still being learned on how best the response should have been handled. This is despite human’s perceived intellectual prowess and current advancement in medical technology and innovation. Vaccines became the centerpiece of the global response to control the pandemic, as was the case with several previous outbreaks. In the process, various factors, actions, and inactions had consequences on the overall and local outcomes of the pandemic including the emergence of new concepts which will have long-lasting effects on the future of pandemic response and global health security. Dissecting the interplay of these factors will be beneficial to future pandemic mitigation and response efforts.

Between 1996 and 2022, over 2200 disease outbreaks were reported across 233 countries and territories, with diseases among those with the highest number of outbreaks being COVID-19, Influenza, Cholera, and Meningitis [1]. The top five countries with the highest number of outbreaks included the Democratic Republic of Congo, Nigeria, the United States of America, Sudan, and Brazil. Sub-Saharan Africa has the highest frequency of disease outbreaks as reported. As of August 2023, over 760

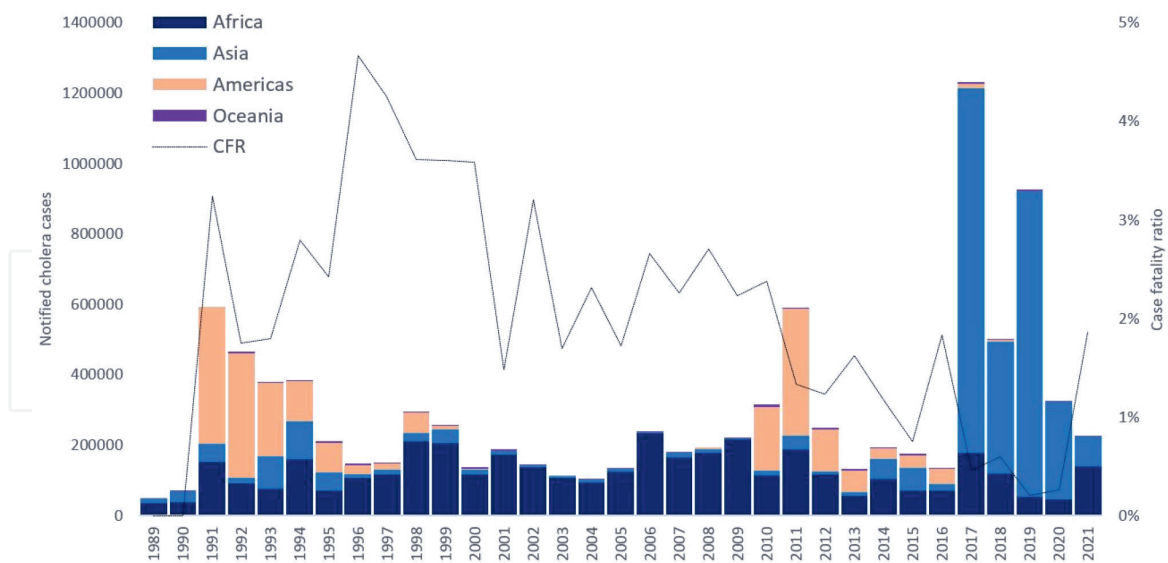


Figure 1. Cholera cases reported to WHO by year and continent between 1989 and 2021. (Source: WHO Cholera – Global situation [3].)

million COVID-19 cases have been reported with about 7 million deaths [2]. Similarly, there has been a surge of cholera cases globally with about 30 countries reporting cases as of the end of 2022 most of which have prolonged cases [3]. **Figure 1** shows the annual case distribution of Cholera over the past several decades. Thousands of cases of Measles and other diseases have also been reported over the years.

Most of these diseases can be controlled through vaccination. Vaccines are one of the most cost-effective public health interventions with a net high return on investment greater than 20 for each dollar spent [4, 5]. It is stated that the full value of vaccinations is not fully quantified through a lot of these economic evaluations, for example, the impact of reduced resources consumed by the hospital from a future antimicrobial resistance or management of secondary diseases that may emanate from non-control of the primary vaccine-preventable disease (VPD) entity [6]. The value of vaccines cannot be overemphasized with the crucial role it continues to play in the control and eradication of diseases such as smallpox and the polio virus [7, 8]. Several new vaccines have been made available recently targeting both subsisting and (re)emerging diseases [8–10]. Unlike medicines that treat an existing infection, vaccines improve population immunity against the disease by making people resistant to the infection or its severe form [8]. This was the case with the COVID-19 pandemic where vaccines contributed substantially to controlling the disease: potentiating the effect of nonpharmaceutical interventions (NPI) [11]. It is pertinent to always correct the notion that vaccines are not cure but prevention, which is a misconception often seen in people with limited understanding of the role and mechanism of action of vaccines.

Vaccines remain the most complex medical products to develop, from conceptualization to pre-approval when sufficient evidence of quality, safety, and efficacy have been obtained and scrutinized to ensure they are much more beneficial relative to any risks they may portend associated with their use [12]. In emergencies, vaccines having satisfied all the standards get pre-approved as emergency use listing (EUL) to allow for rapid deployment to save lives as seen in the case of the COVID-19 pandemic. Even while they are deployed, robust surveillance is instituted to ensure tracking and reporting of any untoward effects which are referred to as adverse events following immunization

(AEFI), some of which are directly related to the vaccine products with others being coincidental events [13]. Like many medications and even foods, these untoward events are bound to happen in quite a few numbers but that does not take away from the extremely high safety standards accorded these products – nothing like a perfect vaccine, medicine or even food product exists! But people should note the rigorous process of vaccines approval at the national, regional, and global levels where the World Health Organization (WHO) and even national regulatory agencies (NRA) institute very stringent screening and approval processes to ensure the safety of the product being ingested, most especially as these are administered to healthy individuals whose tolerance threshold for reactions will be quite low as against someone who is already sick.

It is one thing to have the vaccine manufactured and approved; available for use and another to ensure the most in need get these vaccines without social, economic, cultural, or even ethnic barriers – the concept of equity in vaccine access and utilization. Health and in effect, vaccine equity ensures each nation or individual gets the opportunity to access quality vaccines unhindered by any personal or individual attributes or associations, including geography or location, gender, wealth, or other socioeconomic variables [14]. The Immunization Agenda 2030 (IA2030) emphasizes equity as one of its three goals (Goal 2: Promoting equity) to highlight its importance in ensuring universal vaccination coverage [15]. There exist inequities across regions, countries, states, or people, in access to and utilization of health services with the world making considerable progress towards reducing these disparities. Emergencies bring out the worst of humanity – greed, as was seen during the COVID-19 pandemic where nations were grabbing vaccines in surplus of their needs without any concern for fellow humans who may not have the quantum of resources to compete and grab as well. This phenomenon has been described by many as vaccine apartheid where over 90% of vaccines were grabbed by rich countries with no iota of concern for the not-so-rich nations [16]. The concepts of vaccine diplomacy or empathy became even more pertinent in the pandemic response [17]. While vaccine empathy described the nation or individual's capability to show sympathy to other nations or individual's needs for vaccines, vaccine diplomacy described the actual effort made by stronger nations and individuals to build mutually beneficial relationships to address the other individual or nation's vaccine needs [17]. We discuss the interplay of these factors vis-a-vis the global health security epidemiology, and what these portend for the future.

2. Nature of global health security

Many nations who hitherto were thought to have built a formidable health system capable of withstanding any threat were seen to falter when confronted with the reality of the pandemic of COVID-19 proportion; you could imagine what would happen if we had something worse. The United States Centers for disease control and Prevention (CDC) [18] describes today's top global health security threats to include:

- Emergence and spread of new infectious diseases.
- Ever-increasing globalization of travel and trade enables disease to spread.
- Rise of drug-resistant, disease-causing pathogens
- Potential for accidental release, theft, or illicit use of dangerous pathogens

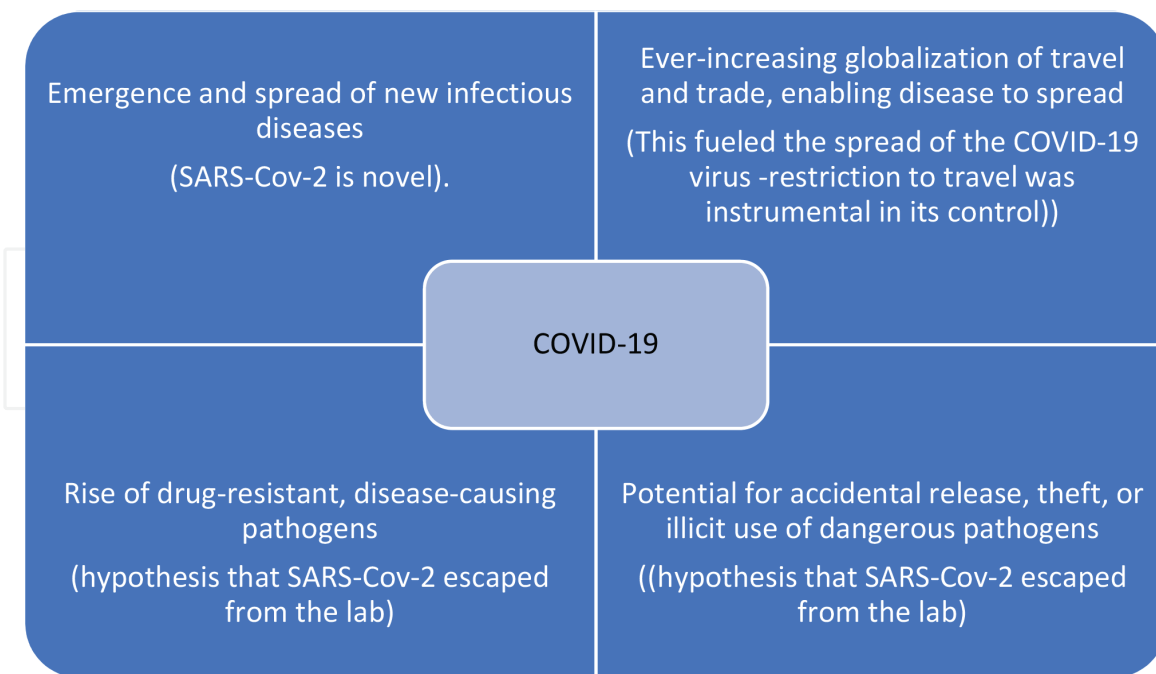


Figure 2.
Triggers and sustainers of global health emergencies.

One or more of the above, or even their mix could lead to a catastrophic and unimaginable global health crisis that needs to be prepared for. Benchmarking these top threats against the COVID-19 pandemic shows an interplay of each of the components to directly or indirectly trigger and sustain the pandemic as shown in **Figure 2**.

Although not all cases of emerging infectious diseases result in crisis, some do lead to large-scale morbidity and mortality. For instance, the COVID-19 pandemic has affected over 700 million persons as reported and resulted in about 7 million deaths; the 2009 H1N1 (swine flu) resulted in more than 284,000 deaths worldwide [2].

2.1 Emergence and spread of new infectious diseases

New and re-emerging infectious diseases are continually seen every day due to predominantly overt or covert human activity which could be intentional or accidental in nature. The US National Institute of Allergy and infectious diseases (NIAD) defines emerging infectious diseases as outbreaks of previously unknown diseases or known diseases that are rapidly increasing in incidence or geographic coverage in the last 2 decades or even persistent infectious diseases that failed to be controlled [19]. Re-emerging diseases are those that reappear after control or significant decline has been achieved and this could be due to human behaviors such as poor antimicrobial usage resulting in antimicrobial resistance (AMR) or even disruption in public health measures. Infectious diseases are (re)emerging quite fast with about 40 infectious diseases discovered since 1970 [18]. Some of these diseases of note include the severe acute respiratory syndrome viruses (SARS), the middle east respiratory syndrome virus (MERS), the Ebola virus, the Chikungunya virus, the Avian flu, the Swine flu virus, The Zika virus and most recently COVID-19, caused by a new coronavirus, SARS-CoV-2. The spread of these diseases is facilitated by globalization making them a global threat that could or have resulted in a pandemic which is a globalized spread of a health threat.

2.2 Ever-increasing globalization of travel and trade enables disease to spread

We live in an increasingly globalized world with travel, trade, and other human endeavors bringing people closer to each other physically or otherwise. Most infectious diseases are spread by contact or near contact through aerosols, airborne, body fluids, etc. The more people mingle and connect the easier it is to spread these diseases. It is challenging to restrict travel and human contact in an increasingly globalized world. Of most concern is international travel and the challenge thereof in limiting potentially deadly infectious diseases within borders [20]. A potent way to provide immunity against such diseases in these contexts will be prior exposure to the pathogen which carries potential for severe morbidity or mortality, or to use vaccines or immune products.

2.3 Rise of drug-resistant, disease-causing pathogens

More and more pathogens are becoming drug-resistant resulting in the re-emergence of previously controlled diseases spiking into outbreaks and epidemics. Antimicrobial resistance (AMR) is therefore a pandemic serving as a precursor for more pandemics in a chain-like reaction. Data suggests an estimated 4.95 million deaths associated with bacterial AMR in 2019 with the highest all-age death rate attributable to resistance seen in western sub-Saharan Africa put at 27.3 deaths per 100,000 [21]. While rich countries do face this serious menace, the data clearly shows a more daring situation in poorer countries of sub-Saharan Africa. Some of the top threats from AMR include *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella pneumoniae*, and *Streptococcus pneumoniae*.

2.4 Potential for accidental release, theft, or illicit use of dangerous pathogens

Several incidents of accidental or purposeful exposure to, or infection by, a highly infectious pathogenic agent have been reported and documented. Some of the causes of these include pathogen mix-ups where two or more pathogens are mixed up in the lab, laboratory accidents as seen in the Anthrax case of 2003 at the University of New Mexico, state bioweapon program accidents as seen in the 1979 Sverdlovsk Anthrax Leak, bioterrorism as seen in the 2001 anthrax mailing incidents [22]. These incidences have been one of the theories depicting the introduction and spread of some notable emerging infectious agents. Evidence on these may be hard to find particularly when the consequences of these actions are large and entities or nations responsible fear the ‘punishments’ that could arise from such which may come with heavy economic implications for the concerned entities.

According to Tom Inglesby, the director of the Center for Health Security at the Johns Hopkins Bloomberg School of Public Health (JHSPH), “*threats to U.S. health, safety, and security include not only major global and regional epidemics of emerging infectious diseases such as Ebola and Zika, but changes to the ways that known diseases, including dengue, chikungunya, yellow fever, and Middle Eastern respiratory syndrome coronavirus (MERS-CoV), are spreading throughout the world.*” [23].

Although many rich nations including the US, were thought to be well prepared to respond to massive epidemics or pandemics, the COVID-19 pandemic did reveal otherwise and showed the reality of unpreparedness of most countries in the world. Some poorer nations fared better than the wealthier ones. Understanding the nature of global health security threat and potential mitigation or control measures which

includes both non-medical and medical measures such as vaccines, and making adequate provisions for equitable access and utilization globally will be pivotal in defeating future global health threats.

3. Approaches to addressing pandemics and epidemics: the role of vaccines

Health system preparedness to mitigate and assist in effectively curbing the future pandemic or global health emergencies should they occur, should be the mainstay of addressing global health emergencies. Some of the preparedness efforts include establishing and sustaining early warning systems, developing a preparedness and response plan including relevant protocols to monitor and mitigate global health emergencies, having a standby governance or command and control center to manage global health emergencies, identifying, and maintaining surge human and material resource capacity, among others.

Response on the other hand relates to the management and mitigation activities following the declaration of a global health event and are often adapted to the events epidemiology which describes the distribution, determinants, and deterrents of the global health emergency. The response often includes curative services meant to treat or cure those who have been afflicted with the condition, and preventive services meant to mitigate the spread of the condition and limit transmission of the disease within the population. The International Health Regulations (IHR) 2005 which is a legally-binding instrument of international law on 196 countries has an overarching legal framework that defines the countries' rights and obligations in handling public health events and emergencies with the potential to cross borders [24]. The IHR has criteria that help the global health community and countries define whether a public health event such as a disease outbreak or epidemic could be classified or need to be declared as a public health emergency of international concern (PHEIC). It also designates steps countries need to take to ensure public health preparedness and response including designating an IHR focal point, improving country disease surveillance capabilities, and safeguards to protect individuals and communities during travels in the event of a public health emergency. To ascertain the applicability of the IHR during pandemics, a panel of about 20 experts reviewed and ascertained the usefulness and appropriateness of the IHR tool [25]. It was noted that many countries did not deploy the full capabilities of the IHR tool as such the deficiencies noted were not those inherently within the tool but from limited application by countries during the COVID-19 pandemic. It is therefore crucial for countries to be sensitized and mechanisms to be put in place such that the full benefits of the IHR tool are harnessed in the event of any future public health event.

3.1 Vaccines deployed in public health emergencies

With most of the global health events being infectious diseases, vaccines have been and will continue to play a central role in both the preparedness and response for these emergencies. During the recent COVID-19 pandemic, many response initiatives were instituted to adapt existing global structures for pandemic preparedness and response and included proposals for a pandemic treaty, a pandemic fund, and mechanisms for ensuring equitable access to medical countermeasures such as the Access to COVID-19 Tools (ACT) Accelerator which includes COVAX which is the vaccines pillar of the ACT accelerator [26]. These interventions signify the agility of the global pandemic

preparedness and response mechanisms, being tweaked to manage the prevailing public health emergency. A lot of lessons were learned which informed some reforms or reorganization of the global health pandemic preparedness and response architecture. Some of these reforms included setting up the COVID-19 vaccine delivery partnership (CoVDP) launched in December 2021 which has supported countries administering over 13 billion doses of COVID-19 vaccines to the most vulnerable and most-at-risk populations including the elderly, those with chronic underlying conditions and health workers. The COVAX mechanism was not without criticisms including the fact that COVAX could not reach half of its goal to distribute 2 billion doses to participating countries which were mostly from the global south by December 2021 [27].

MenAfriVac is another vaccine that has been very effective in controlling and eliminating the devastating epidemics of Meningitis caused by *Neisseria meningitidis* type A, which happen over a cycle of a few years across countries in the Meningitis belt of Africa. Before the development of the MenAfriVac vaccine, several epidemics of the disease happened with one of the most severe one's ever recorded happened around 1996 to 1997 with over 250,000 cases and about 10% case fatality [28]. The incidence of cases has dropped significantly over the years with several of the countries not recording any cases in many years. Thanks to the Bill and Melinda Gates Foundation (BMGF) funded Meningitis Vaccine Project (MVP), several million susceptible people in sub-Saharan Africa were protected with the vaccine which resulted in population immunity. An impact analysis documented about a 57% decline in cases across several countries [28]. Furthermore, the appropriateness of the vaccine characteristics including being licensed for use at room temperature as a controlled temperature chain (CTC) vaccine has contributed immensely to achieving very high coverage and effectiveness [29]. This highlights the value of not only developing vaccines to combat epidemics and pandemics but also ensuring the use of the most appropriate technology in doing so.

Cholera is one of the oldest pandemic-prone diseases with several pandemics recorded over the last two centuries. It is a feco-oral disease which is characterized by watery diarrhea which may result in death without proper fluid and electrolyte replacements or management. The disease outbreak showed a spike in 2022 with more than 29 countries reporting outbreaks. Over 73 million doses of oral cholera vaccines (OCV) were shipped to several countries by the International Coordinating Group (ICG) – a body that coordinates and manages the stockpiles and supply of these vaccines during emergencies, since the stockpile was established. The vaccine is given as a two-dose regimen over 6 months. Due to global shortages, the ICG was able to recommend a single-dose regimen which was shown to be quite effective in an epidemic. The key point of note here is the flexibility of the dosing regimen to adapt to the emerging needs of the public health emergency.

While several epidemic and pandemic-prone diseases have vaccines developed, however, a key challenge for most of the global health events is the non-availability of vaccines at the onset as was the case more recently with Ebola viral disease (EVD), Zika, and the COVID-19 pandemic. Normally vaccines can take 5 to 10 years from conceptualization to pre-approval or approval ready for use. The bulk of the capacity, which goes with funding as well, for vaccine development and commercialization is mostly in the global north – Europe and the US, with some capacity seen in India and China. This lopsided resource positioning creates an unequal race to access vaccines which was typified by one of the worst vaccine-grabbing histories ever known to man manifested during the COVID-19 pandemic seen. This depicts the extant market failure that public goods could face if left in the open market for the strongest buyer

to take. While rich countries accumulated so many vaccines, they ended up donating near-expiry vaccines to many poorer countries who already were grappling with numerous other challenges and were now being faced with the need to race vaccination of expiring vaccines with the limited resources they have. The case of EVD is different since the disease mostly affected countries with limited resources, such as racing to develop and license vaccines within about 6 months was not strongly demonstrated.

Nonetheless, vaccines have shown extraordinary effectiveness in the control of some of these pandemics and epidemics. Several infectious diseases outbreaks such as meningitis, measles, and cholera have in numerous instances been controlled with massive vaccination efforts. COVID-19 was no exception in getting the benefits of being controlled by vaccines. The rapidity of the vaccine development and pre-approval seen during the COVID-19 pandemic was unprecedented and worthy of commendation. However, the process of getting vaccines available within months as against the usual 5 or more years was rather hijacked and used as a weapon by the antivaccination conspiracy theorists to propagate misinformation with the sole aim of festering vaccination rejection and an overall decline in vaccine confidence, which occurred in part across countries. This misinformation propaganda was aided by the globalized world and easy access to information both verified and unverified. The challenge of declining vaccine confidence or hesitancy may keep growing ahead of the next pandemic, as such it is therefore important to keep this in mind and strategize as part of preparedness for the next epidemic or pandemic. It is thus very important to highlight that the whole required processes and steps from vaccine conceptualization to approval were observed but with speed, which made the vaccine products available at a much shorter time duration than usual.

3.2 Innovations

Newer technologies are being deployed in vaccine development to address public health emergencies such as the use of messenger Ribonucleic Acid (mRNA) deployed by pharmaceutical companies during the COVID-19 pandemic. The Meningitis Vaccine Project in the 2000s also developed a conjugate vaccine that was thermostable at room temperature for a few days facilitating seamless vaccine deployment to the remotest of areas in the Meningitis belt. At each moment, the global health community makes efforts to utilize the latest technology including innovating where necessary to develop and deploy effective vaccines for the epidemic or pandemic. mRNA vaccines could have applications beyond infectious diseases to include chronic illnesses like cancer. There is potential for vaccines developed as nasal sprays that will make pandemic prevention and response easier and more widespread. A huge obstacle for many vaccine deployments has been and continues to be the requirement for cold chain storage which if addressed could ease vaccination by improving vaccine reach and decreasing costs [29]. Investing in innovations and more appropriate technology for vaccines portends great benefits for the future of vaccine development with the same or even faster rapidity in the development and deployment of vaccines for public health emergencies as a scale.

4. What did we learn from the vaccination during public health emergencies?

Several vaccines have been and continue to be used during emergencies for either preventive or reactive campaigns including but not limited to COVID-19, meningitis,

Cholera, Ebola, and Measles. Over the years lessons have been learned that highlight the successes and challenges encountered as well as opportunities for improvements. These lessons have guided improvements in vaccination during emergencies and vaccinations overall for an improved outcome. Prior to the COVID-19 pandemic, millions of doses of OCV have been deployed through the ICG from the global stockpile of cholera vaccines set up since 2013 both proactively and reactively. Measles remains an epidemic-prone disease in several low- and middle-income countries, and often large-scale preventive and response vaccination campaigns are conducted with millions of doses every year. The Meningitis burden particularly across the meningitis belt has significantly declined thanks to the Meningitis vaccination campaigns which has been included as part of the routine immunization schedule of some countries. And finally, the Ebola viral diseases outbreak of 2014 to 2016 saw support countries and partners accelerating vaccine development and deployment to contain the disease [30].

Over 13 billion doses of the COVID-19 vaccine were deployed globally as of June 2023 using several vaccine types. These were delivered through the CoVDP or as direct purchases by High-Income Countries (HIC). Due to the priority of the pandemic as a public health emergency of international concern (PHEIC) coupled with the urgency and speed required to deliver the vaccines, nations used a variety of approaches including creating novel platforms often associated with very high political offices to using the routine immunization delivery platforms. This vaccine delivery came at a cost to the primary health care and routine immunization systems. Existing human and material resources for routine immunization and PHC systems were repurposed to not only deliver COVID-19 vaccines but to plan and implement the broader COVID-19 pandemic response. In some instances, parallel systems were established solely for the COVID-19 vaccination and will need to integrate the delivery into existing PHC and RI systems to have a more sustainable platform to continue the control of the virus. Guidelines have been developed to support country integration of COVID-19 initiatives [31].

4.1 Successes recorded

Through the various initiatives by governments, and bilateral and multilateral partners, there were numerous efforts to guarantee supply for low- and middle-income countries (LMIC). To effectively assess the situation is to look at the counterfactual of the non-existence of such initiatives such as the COVAX in aiding country access to COVID-19 vaccines in a timely and affordable manner; the OCV stockpile in containing cholera outbreaks through the ICG or even the traditional measles vaccines to prevent and respond to outbreaks. While the targets and aspirations of the initiatives may not have been fully achieved, credit should be given to the different initiatives and the additional lives that were saved by the little gesture. The Meningitis Vaccine Project funded by the BMGF supported the development and rollout of MenAfriVac which has resulted in the near elimination of *Neisseria meningitidis* in some countries with a significant decline in outbreak frequency and disease mortality across the meningitis belt [28]. The International Coordinating Group (ICG) was established to manage the stockpiles of Oral Cholera Vaccines during emergencies and has been successful in rationing the OCV stockpile, especially during cholera epidemics or pandemics [30]. The pandemic treaty is an intergovernmental negotiating body created by a special session of the World health assembly in late 2021 with the core of it being the equitable sharing of lifesaving medical resources to support health emergency preparedness, response, and resilience [27]. Furthermore, the COVAX

humanitarian buffer is an initiative that provides a safety net for the most vulnerable populations including displaced and conflict-affected persons.

There was enhanced global, regional, and even national coordination for improved vaccination delivery across the different vaccines. Several inter and intra-agency working groups were set up at all levels where governments and partners came together to strategize, prepare, and discuss an equitable model of vaccine allocation and delivery. This often brings a heightened awareness and involvement of the top political leadership on vaccination, more seen during the COVID-19 pandemic. This is an opportunity that could be leveraged for strengthening routine immunization and PHC.

Acceleration of the pace of vaccine development was leveraged during the EVD and even enhanced during the COVID-19 pandemic. With the precedence set, vaccines for responding to public health emergencies could be developed within weeks and deployed to help in controlling the situation. Furthermore, innovations seen during the MenAfriVac, Ebola, and even COVID-19 vaccines have shown a progressive advancement in vaccine technology. But we also learn from measles vaccines that traditional vaccines do have a role to play in epidemic and pandemic disease management.

COVID-19 vaccination brought to fore several issues. The concepts of vaccine empathy and vaccine diplomacy became more pronounced recently. While vaccine empathy refers to an individual or a nation's capability to sympathize with other individuals or nations' vaccine wants and needs, vaccine diplomacy is a nation's vaccine efforts that aim to build mutually beneficial relationships with other nations [17]. Several LMIC countries receive donations of vaccines from high-income countries in an attempt to bridge the widened gap in access and utilization of COVID-19 vaccines which persists to date. **Figure 3** shows the COVID-19 immunity gaps from lower vaccination access and utilization in developing countries.

Some of the vaccines had a very short shelf life resulting in mass expiry of vaccines in the hands of poorer nations who now had to grapple with a double jeopardy scenario of scarcity amid plenty. Another attempt was the struggle with the transfer of vaccine manufacturing technology from Big Pharma in the richer countries to the developing economies. Several issues of intellectual property right came up. There is no way we can achieve an equitable and appropriate global health emergency control when tools

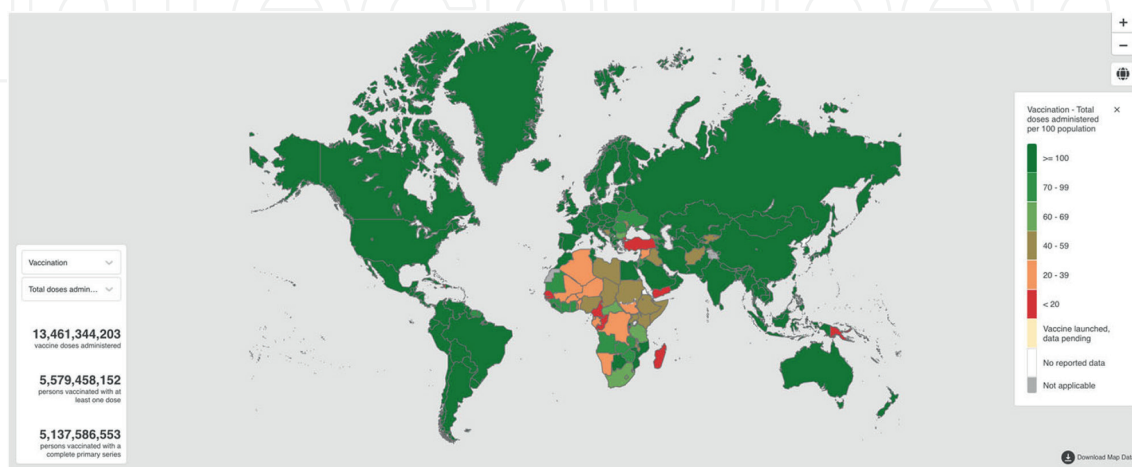


Figure 3. COVID-19 vaccination coverage globally shows developing countries still lagging. This stark difference is driven largely by vaccine inequity. (Source: WHO COVID-19 dashboard.)

needed for effective preparedness and response are left solely to market forces without meaningful interventions. Some waivers of intellectual property rights and mutually beneficial technology transfer are needed to effectively manage any future emergency.

4.2 Challenges encountered

For most of the vaccines deployed for epidemic or pandemic mitigation and response, shortages were universal. This results in coordinating bodies reorganizing themselves to ensure vaccines are widely distributed as possible while providing the desired effectiveness. Vaccine shortages have been seen with cholera vaccines which resulted in a revision of the dosing regimen from 2 to 1 dose during an outbreak response to accommodate as many susceptible persons as possible. The shortages seen in the COVID-19 era were phenomenal where richer nations were seen to use their wealth and power in securing excess vaccines for their people with little or no consideration for the poorer countries until much later in the response.

The African Union set up a 10-member team in August 2020 known as the African Vaccine Acquisition Task Team (AVATT) chaired by The President of South Africa Cyril Ramaphosa. The AVATT's key aim was to ensure the continent secured sufficient COVID-19 vaccines to protect its close to a billion population. Cyril Ramaphosa is one of the notable persons from the continent who have been vocal on the COVID-19 vaccine allocation and manufacturing disparity. Using the terrible experiences from South Africa's long dark history of racial injustice, he refers to the vaccination injustice as a vaccine apartheid that must be ended.

“Although the advent of coronavirus vaccines has broadened the frontiers of hope for a sustainable global recovery, the inequitable distribution of these vaccines means that the recovery will be uneven and, potentially, short-lived. If the world is to overcome the pandemic in 2022, it needs to end vaccine apartheid.” – President Cyril Ramaphosa [32]. His words are loaded with wisdom and carry a strong but reassuring message to the world that for any global health security to be properly managed, equity and social justice in preparedness and response efforts are pivotal. Several discussions and negotiations ensued with many actors including the World Trade Organization, the WHO, and World Intellectual Property Organization finally securing a Trade-Related Aspects of Intellectual Property Rights (TRIPS) COVID-19 vaccines waiver in July 2022 to potentially cover COVID-19 diagnostics and therapeutics.

Recently in his remarks at the summit for a New Global Financial Pact in Paris, President Ramaphosa stated that there persists resentment towards the West due to the treatment meted on African and poorer nations during the pandemic response and he stated that African nations “felt like we were beggars when we needed access to vaccines.”

These are the consequences of one of the most historic vaccine grabbing ever witnessed by mankind where rich countries secured pre-manufactured vaccines in multiples of their population needs and requirements and dolled off the leftover with mostly short shelf life to poorer nations when these countries have achieved a certain level of control of the pandemic already. We must implement and not just vocalize concrete steps towards this vaccine equity and interventional appropriateness hearing the voices of all concerned before pushing the bitter pills down the throats of the marginalized.

Some of the key challenges summarized by Lal et al. included an over-reliance on global health security interventions at the expense of broader universal health coverage (UHC), gaps in mitigating socioeconomic factors and wider determinants of health, and the lack of inclusive and equitable engagement mechanisms in public health decision making [26].

5. Future approaches (recommendations and conclusions)

To better achieve vaccines and interventional equity and appropriateness for global health security, certain fundamental steps will need to be taken particularly with the many learnings from the COVID-19 pandemic response.

5.1 Governance, one and equal voices

The global health landscape was awash with numerous coordinating bodies and structures striving hard to make a difference building on experiences from previous public health events. No doubt this provided a platform, which some may argue as unequal, to allow for some meaningful engagements and discussions. The different initiatives set up including the COVAX, the pandemic fund, etc. were borne from these coordinating bodies where key issues related to ensuring an overall framework for global health security. At the global, regional, and national levels, some form of governance was instituted and played a key role in the pandemic response. It is important to leverage these structures and reposition them for preparedness starting now and not wait till the next global health threat. Progress is being made with setting up hubs such as the WHO Hub for Pandemic and Epidemic Intelligence. Are these bodies equitable in their decision-making arms? While LMICs should work on strengthening their institutional weaknesses to have more resilient systems, they must be given a seat and be heard during preparedness and response to ensure a healthier world for all. Keeping poorer nations as mere recipients of crumbs will not in any way better global health security but result in protracted crises.

5.2 Development and manufacturing of vaccines

The TRIPS waiver secured for the COVID-19 vaccines was a welcome development but came albeit late to transform the COVID-19 pandemic response, but will be a valuable tool for future public health threats. A clear framework and process to fasten the transfer of technology and waivers for intellectual property rights should be available and should be pre-approved at the inception of vaccine trials. LMICs should be carried along in the development stride for vaccines and tools for mitigating or managing global health threats. Equal participation in pre-clinical and clinical trials to ensure the appropriateness of an intervention finally certified for use. The Big pharma and rich nations who often invest in the Research & Development (R&D) of the pharmaceutical companies should take deliberate positive steps to fully transfer technology and support vaccine manufacture in LMICs. AstraZeneca was one company that made great progress in that area, and we can build on the successes so far. But also, LMICs must promote national policies and investments to support local R&D and be ready to share technology with rich countries as well. This is towards a mutually beneficial model which will see effective vaccine diplomacy for the overall global good.

5.3 Pre-approval and licensing

One of the weaknesses of LMICs is in the regulation and approval of medicinal products through their respective national regulatory authorities (NRA). Deliberate collaborations should be established between countries with well-developed NRAs and LMICs to ramp up capacity and support preparedness and response for future

emergencies. The pre-approval and licensing of vaccines are managed through a robust process by the WHO. A means to socialize better the process and refining to mitigate issues related to countries pushing for vaccines to be released ahead of WHO pre-approval.

5.4 Procurement and distribution

Several developing countries do not have the resources or mechanisms for cost-effective procurement and distribution of vaccines. Mechanisms for supporting the pooling and procurement of vaccines for LMICs, a much-improved version of the COVAX and similar tools will be beneficial.

5.5 Sustainable initiatives

Responding to global health emergencies often requires extraordinary measures which may mean creating separate coordination structures and systems to battle the emergency and restore normalcy. Efforts should be made to leverage and strengthen existing systems by incorporating resilience in preparedness and response plans including conducting sustainability assessments where feasible. Scenario analysis and drills to prepare adequately for global health emergencies will be quite useful.

6. Conclusion

This chapter discussed the pivotal role of vaccines and interventional equity and appropriateness citing sources from the several vaccines deployed during public health emergencies including Oral cholera, Ebola, Meningitis, Measles, and the COVID-19 pandemic. Drivers of inequity in vaccine development, procurement, distribution, and use were discussed and suggestions were made. Several initiatives were discussed including the Meningitis Vaccine Project, the ICG for Cholera vaccines, the COVAX humanitarian buffer, vaccine apartheid, grabbing, etc. Finally, future approaches to guarantee global health security were summarized.

Conflict of interest

The authors declare no conflict of interest.

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